NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

MANUAL FOR NACA EDITORS

Washington
October 1952

TABLE OF CONTENTS

PREFACE

The revised edition of the United States Government Printing Office Style Manual, dated January 1945, is the guide for preparation of all NACA publications. The Manual for NACA Editors is primarily a supplement to the GPO manual indicating exceptions and additions to GPO rules necessary because of subject matter peculiar to aeronautical research.

This manual and the GPO manual cannot cover all the reference material an editor will need; therefore, other authorities should be studied. The second edition, unabridged, of Webster's New International Dictionary is the accepted authority for the defining of nontechnical terms and for the spelling and compounding of words not given in this manual or the GPO manual. NACA Report 474, 1941, gives definitions of aeronautical terms. For new technical terms recognized authorities and publications in the field should be consulted. For grammar standard college textbooks should be used and for style in technical writing books such as A. C. Howell's A Handbook of English in Engineering Usage (John Wiley & Sons, Inc., 1940) are recommended. In addition, current publications in the field of aeronautics should be watched for trends in usage and style.

When a laboratory has a recommendation regarding usage not covered by this manual and that of the GPO, such information should be forwarded in a brief memorandum to NACA Headquarters for approval and subsequent circulation to all the editorial offices. This manual has been prepared in loose-leaf form to facilitate insertion of additions and necessary revisions to the original sections.

Much of the material in this manual is a reorganization of sections in the NACA Style Manual for Engineering Authors by Pearl I. Young, which is now out of print.

PARTS OF AN NACA PAPER

TITLE

The title of a paper should adequately describe the contents as concisely as possible. When applicable, the method of investigation and most important test conditions should be given in the title. Superfluous articles should be deleted and only punctuation necessary to retain the sense should be used. If a title extends over more than one line, the lines should be broken with regard to sense as well as balanced appearance. Roman numerals should not be used to designate the parts in a series of papers unless at least two parts are ready for publication. When the parts are not numbered, the main title and subtitle should be separated by a dash or set up on different lines.

On the first page of a printed report or a converted typed paper, except when the superseded version is still classified, a footnote is given to identify the number, title, authors, and date of the superseded paper or papers. The footnote reference mark is placed at the end of the title.

Titles are set in capital letters. For printed reports the case and font of type face must be indicated. (See "Type Faces for Printed Reports.") When a printed report is in the galley-proof stage, running heads must be supplied to the printer for the tops of the pages as follows:

Even page head:
REPORT 0000 - NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

Odd page head:
Entire title or, if the length of the title extends over 93 spaces, a shortened version of title

HEADINGS

As in all standard outlines, coordinate headings should be in parallel construction. Both the construction and setup of headings follow the principles stated for titles. Each heading should have at least one corresponding heading; exceptions to this rule include such cases as an occasional short remark or a single example put in to illustrate a method. A heading is not an integral part of a section of the paper; therefore, the text should be independent of each heading.

Whenever possible, the headings of a paper should be kept within three grades. In typed papers these grades are, in order of introduction (except in rare cases): Main center heads, all capital letters; subordinate center heads, main words capitalized (see GPO manual, p. 157, rule 284 (a)); and run-in side heads, first word capitalized and entire heading indented as for a paragraph, underlined, and followed by a period and a dash. If a fourth type of heading is absolutely necessary, centered headings set in underlined capitals may be introduced before the main center headings or indented run-in side heads, first word capitalized and entire heading followed by a colon, may be introduced after the underlined run-in side heads.

EXAMPLES:

HEADING

HEADING

Heading

Heading.-

Heading:

For headings in printed reports the case and font of type must be marked. (See "Type Faces for Printed Reports.")

The term "part" is not included in any heading because in printed reports the GPO will begin a new page at such a break. If it is desirable to indicate several distinct parts in a paper, the different first-grade headings of the separate divisions should be identified by Roman numerals followed by periods. Except for such divisions numerals and letters showing correlation of the headings should not be used unless they are necessary for frequent cross reference within the text.

TABLE OF CONTENTS

A table of contents is rarely used in either a printed report or a typed paper; however, a long paper may be preceded by a table of contents to permit easy reference to particular sections. When such a table is given, the author should decide how detailed it should be; that is, he should choose the grades of headings to be listed. All headings of comparable grade should be given; for example, if some subordinate center headings are given, all subordinate center headings should be. The headings are capitalized in the table of contents as they appear in the report and are indented to show their grades. Leaders are used from the

headings to the page numbers. In addition to the headings, tables and figures at the end of the paper are listed as "TABLES" and "FIGURES" and the page numbers of the first table and figure are given.

A table of contents in a printed report will be carried over to the bound volume and pagination will be corrected.

SUMMARY

NACA papers always begin with a summary, which is a concise and accurate condensation of the entire paper. Although this section is characterized by briefness, the following items should be included: The object and scope of the work, the information obtained, and the main conclusions reached. Only essential ideas should be given and specific statements are of more value than generalities.

From the summary readers, indexers, and bibliographers should be able to obtain a fairly complete idea of the material contained in the paper. For this reason, the summary should be an independent unit; therefore, mention of equations, tables, and figures by number must be avoided, symbols must be adequately defined, and references must be identified other than by the number given in the list.

INTRODUCTION

The introduction serves as a preparation for the material to follow and relates the current work on the subject to the field. As much of the following material as is applicable should be included in any logical order:

(1) The status of the problem prior to the present research

(2) The purpose of the investigation precisely defined

(3) The conditions under which the work was done and the procedure, if unusual

(4) The scope of the present work and its connection with the general problem

(5) Recognition of similar work on the subject

(6) Significance of the material treated

In addition, it may be desirable to state where and when the work was done. Such mention should occur in the introduction unless it is specifically included in a following section.

If valuable help has been received from a person not connected with the investigation, a brief courteous acknowledgment can be made at the end of the introduction; the person should be mentioned by full name and title. The organization with which the person is associated should be added after his name if the contribution was a result of his affiliation with the organization.

BODY OF PAPER

Sections that may be included in the body of an NACA paper are given in the following discussion. No one paper may need all the sections given, but this listing indicates possible ones and shows their usual location in the paper. Often two or more sections are combined. Even when fewer sections are used, the material should preferably be arranged in the indicated order. Any concise appropriate headings may be used for the sections.

Symbols

All symbols used in a paper, including those used in tables and figures, should be defined. If many symbols occur, they should be listed with their definitions and units as a separate section. This section usually follows directly after the introduction, but it may advantageously be an appendix when, for example, the list is very long, the symbols are used only in other appendixes, or the use of the symbols is far removed from the end of the introduction. All significant symbols used in the paper should be included in such a list. Isolated or incidental symbols may be omitted from the list and defined when introduced. When necessary for clarity, symbols may be redefined elsewhere in the paper.

If only a few symbols are used in a paper, the section giving the complete list may be omitted and each symbol defined where it is introduced. Such definitions may be run in the text or set off from the text in list form.

When symbols are defined in a list either in a separate section or set off from the text, different kinds of additional explanatory material, such as formulas, units, and so forth, are given after the various

definitions. The following forms for setup of this material represent cases which frequently occur.

Definition with formula:

a_o slope of section lift curve per degree, $dc_l/d\alpha_o$

Definition with formula and unit:

d section drag, dD/dy, lb

Definition with unit:

F_s stick force, lb

Definition with unit and reference to a part of the paper:

V_i indicated airspeed, ft/sec (fig. 4)

Alphabetical order is preferably used for listing symbols, although any logical arrangement is permissible. In an alphabetical list the English symbols should precede the Greek symbols, which are followed by the subscripts and then the superscripts. Capital symbols should precede the corresponding lower-case symbols.

Whenever practicable, only symbols accepted as standard by the NACA should be used. Several published NACA symbols lists are available (see Technical Notes 1507, 1508, and 1604) and also "Letter Symbols for Aeronautical Sciences" (Z10.7-1949) published by the American Standards Association is a standard authority. For additional symbols usage in current American papers by recognized scientists should be followed. An adequate reason should exist for any deviation from established usage. For example, when two quantities used in the same section of a paper have identical standard symbols a temporary secondary symbol should be used for the less important one in order to avoid confusion.

Necessary nonstandard symbols should be chosen in harmony with principles shown by standard symbols. When new symbols are introduced, a single letter preferably should be used to represent each concept because two or more letters usually constitute a product or an abbreviation. If it is necessary to use a long, involved expression which recurs frequently, it may be replaced by a single symbol after its first appearance. Symbols for which no standard type exists should be avoided in printed reports because of the expense of making a new font and in other papers because of the difficulty of drawing them in by hand.

When material is quoted or restated from outside sources, any symbols included in the quotation should be defined. Sometimes it may be desirable

to change these quoted symbols to avoid conflicts with other symbols, since throughout a paper one symbol should be used to denote a concept. Even if there are no conflicts, it may be advisable to change the symbols to standard notation if they are obviously nonstandard. Any change in the notation of quoted symbols should be acknowledged.

EXAMPLE:

> Brown has collected a large amount of empirical knowledge on n_h (called n_t in ref. 15).

If it is desirable to retain the notation of the quoted material, this should usually be acknowledged also.

EXAMPLE:

> The appropriate solution of the wave equation, in the notation of reference 2, is found to be . . . .

Description of Apparatus

For papers presenting experimental data the section following the symbols list is usually a brief but adequate discussion of the apparatus used, the material employed, the models tested, and the experimental setup. Unless the equipment is new or modified, suitable reference to a published description is satisfactory. Dimensions and descriptions of unmodified permanent equipment should be kept in the present tense. Trade names of equipment or material, including aircraft and engines, may be used if necessary for identification and if no evaluation is presented. Trade names and designations should be carefully checked for correct form. Any sketches or photographs of the equipment, setup, and tests in progress should be referred to in this section.

Procedure

In an experimental paper an accurate description of how the data were obtained should be given. The range of variables should also be given. If the method exactly follows the method previously used in a similar investigation, the details may be condensed and the previous paper mentioned as a reference.

In a theoretical paper this section will probably become one in which the method of analysis is discussed and is often combined with the statement of the problem and the basis of the theory.

Precision

In many papers it is advisable to give numerical values showing the precision of the equipment and of the data, either as percentages or as actual values with units. Discrepancies within the data should be explained. The precision can be given in a separate section, or the accuracy of the instruments may be included in the description of the apparatus and the precision of the final results may be stated when the results are presented.

Results

A well-organized and objective presentation of the results should be given. Proprietary results that evaluate a product must never be included without permission of the manufacturer. Not only the results but also the method of computation or derivation used to obtain them should be presented unless it is described in another section, for example, "Procedure." If the method is involved, one complete example may be included; however, if this example entails a lengthy computation or derivation, it may be put in an appendix and only the main steps indicated under "Results."

Tables and figures that show the results should be referred to in this section. A tabular form for the results is more useful if many readers might want to plot the results in a variety of forms; graphs are preferable in showing trends and comparisons. All statements about the results and any numerical values cited from them should agree precisely with the tables and figures.

If data are of interest to only a few readers, such data may be omitted from a paper to save space and a statement inserted in the text concerning their availability. An example of such a statement follows:

> The basic results are presented in the form of curves. The test data have been tabulated and are available upon request from the National Advisory Committee for Aeronautics.

Tables and figures for loan should be in standard NACA style and form for reproduction.

In short papers the presentation of results may be combined with other sections, such as "Procedure" or "Discussion." The heading should be altered accordingly, for example, "Results and Discussion."

Discussion

Discussion of the results, together with their analysis, to show that the conclusions are warranted is one of the most important parts of the paper. Each major conclusion should be clearly proved and presented; any opposing theories should be clearly explained and comparisons should be made with results of similar work by other investigators. If the results have an immediate application, this should be pointed out in the discussion and, if possible, an example should be worked out to show the method of application. All statements should be clear to readers who are in other fields of aeronautical science and may not be so well acquainted with the subject as the author.

No promises of future research should be included. Suggestions for future research should not be mentioned unless the discussed results are insufficient or unless the suggestions are of a general nature. In some papers these recommendations for future research may be presented apart from the discussion as a brief concluding section.

CONCLUDING SECTION

Most research papers close with an itemization of the conclusions formulated in the discussion or of the main results presented in the text. Conclusions and results are defined as follows:

Conclusions - general results applicable to the field of research concerned

Results - specific results applicable only to the conditions of the investigation reported

In accordance with their definitions, conclusions are usually stated in the present tense and results, in the past tense.

A paper should not have two concluding sections, such as both a section of conclusions and a section of summarized results. If it is necessary to present results with the conclusions, they are incorporated in one section titled "Conclusions." Any itemization of conclusions or results should be introduced by a short statement identifying the case investigated.

Because of the general significance of conclusions, their exact meaning should not be dependent on any other parts of the paper. For this reason, mention in "Conclusions" of equations, tables, and figures by number must be avoided, symbols must be defined, and the references

must be adequately identified other than by their number in the list. It is also desirable, but not essential, that a "Summary of Results" be independent of the rest of the paper.

If neither conclusions nor summarized results are appropriate as a concluding section, a paper may end with the discussion, with a short section "Concluding Remarks," or with a brief section of recommendations for future research. (See "Discussion" for material to be included in a section of recommendations for future research.)

A date line giving the place the work was done and the date of the final typing of the paper should be inserted at the end of the concluding section. (See GPO manual, p. 140, rule 226.)

APPENDIXES

Related material desirable as supporting evidence but not essential to the development of the paper itself - material such as specifications, a list of symbols, or involved mathematical derivations - may well be placed in an appendix following the concluding section. Only in rare cases are groups of tables or figures presented as an appendix.

Appendixes should be referred to in the text because only material closely enough related to the text to warrant mention should be appended. For reference each appendix of a group should be identified as appendix A, appendix B, and so forth, but a single appendix need not be thus identified. In addition, any appendix should be given a title (first-grade heading) whenever possible. Appendixes should preferably be arranged in the order of their mention in the text. This order, however, may not be feasible if it is desirable to maintain a certain logical arrangement or grouping; for example, the most preferable position for easy reference to a list of symbols, which is one of a group of appendixes, is either first or last.

In typed papers each appendix begins on a new page. In order to save space in printed reports, however, an appendix follows continuously after the signature. The heading is set full measure and the text is set in two columns beneath it. For numbering of equations in appendixes see section entitled "Mathematical Expressions."

REFERENCES

Publications directly referred to in a paper should be listed under the heading "References" and placed after the concluding section of the

paper or, if the paper has appendixes, after the text of the last appendix. Such listed references are numbered in the order of their mention in the text, tables, and figures. (Referring in the text to a table or figure that contains mention of a reference does not constitute mention of that reference in the text.) When a paper is a complete or a definitive treatment of a subject, the section "References" may be followed or replaced by a bibliography of all the important matter pertinent to the investigation. Publications listed in the section "Bibliography" are usually not numbered and are given in alphabetical order, in chronological order, or in groups according to subject matter.

Authors should give as listed references only the papers they have actually seen. If an original source is unavailable to an author and thus he has used a secondary source, the secondary source should be listed; however, if desirable, the original source may be added in parentheses. When the author has used an original source of a work which is also available in translation as an NACA Technical Memorandum, the following note should always be given in addition to the reference: "(Available in English translation as NACA TM 0000.)." This information is given because of the availability of Technical Memorandums from the NACA. When an NACA paper is cited that has been previously available in a different NACA publication series, the original source is given after the formal reference, for example, "(Supersedes NACA TN 0000.)."

When an author has used a paper of limited availability or an unpublished work, it should be identified as such in the reference list to save the reader unnecessary trouble in trying to obtain it. In some cases the source information for a reference will adequately indicate its availability; for example, because it is well-known that graduate theses are not generally available, no explanation should be necessary with the reference listing. In other cases a parenthetical note such as "(To be published in Jour. Aero. Sci.)" or "(Available from . . . .)" should be added. It should be noted that such papers must be formal documents in order to be listed as references. Informal sources of information such as private communications are not suitable for referencing in the list but, if necessary, may be acknowledged in the text. A prospective NACA printed report cannot be referenced until it has been assigned a number; all other prospective NACA publications cannot be referenced until they are formally approved for publication. In NACA unclassified papers material of a classified nature cannot be referenced or mentioned. (For references in classified papers see "Suitable Reference Material for Formal Citation in NACA Releases," which is issued periodically by NACA Headquarters.)

The following information should be given for each work in a reference list or bibliography: Author's surname, author's first name or initials as given on the cover or title page (the abbreviation "et al." may be used for five or more authors), and exact title of the work in

the language in which it is written, with careful attention to spelling, accent marks, and capitalization. (See GPO manual, p. 157, rule 284 (a), for capitalization of English titles and, pp. 279-377, for capitalization of foreign titles.) If desirable, a translation of the title may be added within parentheses. A dash should be inserted between the main title and the subtitle of a reference that in the original has the titles set up on separate lines; otherwise, titles and subtitles are listed exactly as they appear on a publication. In addition, (1) for a book there should be given volume, edition, publisher (if publisher is not well-known, place of publication should be added), date (if no date of publication is given, use copyright date as "c.1944"), and page numbers if specific pages are used; and (2) for a periodical there should be given the name of the periodical and complete source information such as volume, number, month, year, and inclusive pages. If the name of a periodical has undergone changes, the correct name for the issue cited should be given. If a publication is referred to several times in a paper and all the citations are not to the same part of the publication, the page numbers of each part are preferably given at the appropriate time of mention. For a book this will replace the page numbers with the reference listing and for a periodical will be in addition to the inclusive page numbers given with the reference.

Although references are checked by editors, the author is responsible for their accuracy. The author should see that the information for each reference is correct and adequate and that all citations in the paper are to the proper reference. It is also the responsibility of the author to see that all reproduced data are acknowledged not only by listing their sources as references but also by identifying the sources at the places where the data are given, that is, in the text, in a table or its title, or within a figure or its legend. If reproduced material is from a copyrighted work, the author must obtain permission from the publisher to use it.

The forms for some types of references used in NACA papers are as follows:

Books

One edition:	Dodge, Russell A., and Thompson, Milton J.: Fluid Mechanics. McGraw-Hill Book Co., Inc., 1937.
Revised edition:	Boyd, James E.: Strength of Materials. Fourth ed., McGraw-Hill Book Co., Inc., 1935.
One volume of a series:	Fuller, Charles E., and Johnston, William A.: Applied Mechanics. Vol. II. John Wiley & Sons, Inc., 1919.

Foreign book:	Flügge, W.: Statik und Dynamik der Schalen. Julius Springer (Berlin), 1934.
Translation:	Jost, Wilhelm (Huber O. Croft, trans.): Explosion and Combustion Processes in Gases. McGraw-Hill Book Co., Inc., 1946.
Edited book:	Eshbach, Ovid W., ed.: Handbook of Engineering Fundamentals. Vol. I. John Wiley & Sons, Inc., 1936.
One section of an edited collection:	Betz, A.: Applied Airfoil Theory. Airfoils or Wings of Finite Span. Vol. IV of Aerodynamic Theory, div. J, ch. III, sec. 5, W. F. Durand, ed., Julius Springer (Berlin), 1935, pp. 56-62.
Book compiled by a staff:	Staff of Battelle Memorial Institute: Prevention of the Failure of Metals Under Repeated Stress. John Wiley & Sons, Inc., 1941.
Book of anonymous authorship:	Anon.: SAE Handbook. SAE, Inc. (New York City), 1949.

Periodicals

Foreign:	Gebelein, H.: Über die Integralgleichung der Prandtlschen Tragflügeltheorie. Ing.-Archiv, Bd. VII, Heft 5, Oct. 1936, pp. 297-325.
American:	Evans, Thomas H.: Tables of Moments and Deflections for a Rectangular Plate Fixed on All Edges and Carrying a Uniformly Distributed Load. Jour. Appl. Mech., vol. 6, no. 1, Mar. 1939, pp. A-7 - A-10.
Paper with discussion in same issue:	Beitler, S. R.: The Effect of Pulsations on Orifice Meters. Trans. A.S.M.E., vol. 61, no. 4, May 1939, pp. 309-312; discussion, pp. 312-314.
Paper with discussion in different issue:	Goland, Martin, and Luke, Y. L.: The Flutter of a Uniform Wing with Tip Weights. Jour. Appl. Mech., vol. 15, no. 1, Mar. 1948, pp. 13-20. (See also Discussion by R. H. Scanlan, Jour. Appl. Mech., vol. 15, no. 4, Dec. 1948, pp. 387-388.)

The discussion should not be referenced if the material used is in the main paper only. If a discussion consists of comments by several people, the person who furnished the part of the discussion referred to should be mentioned by name in the text.

NACA Publications

Report: Reissner, Eric: On the Theory of Oscillating Airfoils of Finite Span in Subsonic Compressible Flow. NACA Rep. 1002, 1950. (Supersedes NACA TN 1953.)

Technical Note: Neurath, Peter W., and Koehler, J. S.: Creep of Lead at Various Temperatures. NACA TN 2322, 1951.

Technical Memorandum: Ringleb, F.: Some Aerodynamic Relations for an Airfoil in Oblique Flow. NACA TM 1158, 1947.

Research Memorandum: Wier, John E., Pons, Dorothy C., and Axilrod, Benjamin M.: Effects of Molding Conditions on Some Physical Properties of Glass-Fabric Unsaturated-Polyester Laminates. NACA RM 50J19, 1950.

Foreign-Government Publication

British R. & M.: Squire, H. B., and Trouncer, J.: Round Jets in a General Stream. R. & M. No. 1974, British A.R.C., 1944.

School Publications

Bulletin: Fried, Bernard, and Weller, Royal: Photoelastic Analysis of Two- and Three-Dimensional Stress Systems. Bull. No. 106, Eng. Exp. Station, Ohio State Univ. Studies, Eng. Ser., vol. IX, no. 4, July 1940.

Foreign school report: Tanaka, Keikiti: Air Flow Through Suction Valve of Conical Seat. Part I. Experimental Research. Rep. No. 50 (vol. IV, no. 9), Aero. Res. Inst., Tokyo Imperial Univ., Oct. 1929, pp. 259-360.

Thesis for a degree: Krebs, Charles V.: Determination of Stress Concentration Factors for Hyperbolically Notched Tension Members. M. S. Thesis, Univ. of Notre Dame, 1950.

Commercial Publication

Industrial report: Howell, F. M.: Tensile Properties of XB18S-T at Elevated Temperatures. Rep. 9-45-2, Aluminum Res. Labs., Aluminum Co. of Am., Mar. 23, 1945.

TABLES

Tables are important because they present data in a highly concentrated form. Tabulations may include simple listings in two or more columns, many columns with multiple headings, or even complicated computing forms. Because of the importance of tables, the underlying principle for all rules should be clarity, and each table usually should be a unit independent of the text. Rules cannot always be uniformly followed; however, whenever possible, the NACA follows the rules for tabular material given in the GPO manual, pages 123 to 134, with the exceptions and additions noted in the following discussion.

Numbering

Tables are usually placed at the end of the text and numbered consecutively with either Roman or Arabic numerals in the order of their mention in the text. (Exception to this order may be made when mention of the table is clearly incidental.) Unnumbered tables which are an integral part of the paper can be left directly in the text. Such tables are prefaced by introductory remarks, are usually short, and may or may not have titles. Numbered tables are left in the text of typed papers only if both of the following conditions occur simultaneously: The text is dependent upon the position of the table for the development of an idea and also numbers are necessary for frequent reference to the table. In printed reports numbered as well as unnumbered tables may be inserted in the text where they are first mentioned if this arrangement is desirable and causes no make-up difficulties. In any case, in the manuscript of a printed report all ruled tables must be kept on separate sheets for the convenience of the compositor.

No table should be included in a paper if it has so casual a connection with the subject that mention of the included data is unnecessary.

Titles and Headnotes

The title is an integral part of the table and should be as exact and descriptive as possible. Additional information about the test conditions that applies to all the data in the table is given in a bracketed headnote beneath the title. Titles should be set up in either of the two following forms and centered above the table:

TABLE IV.- EFFECT OF AGING ON CREEP PROPERTIES OF ALUMINUM

TABLE IV

EFFECT OF AGING ON CREEP PROPERTIES OF ALUMINUM

Corresponding forms for titles with continued parts of a table are as follows:

TABLE IV.- EFFECT OF AGING ON CREEP PROPERTIES

OF ALUMINUM - Continued

TABLE IV.- Continued

EFFECT OF AGING ON CREEP PROPERTIES OF ALUMINUM

For the last page of a continued table the word "Concluded" is used instead of "Continued."

If it is necessary to use subtitles, the letters designating them are enclosed in parentheses. (See section on subdivisions.)

Box Headings

Box headings should be brief. When necessary, they may be amplified by footnotes. (See section on footnotes.) Only the initial word of a box heading should be capitalized. A quantity, its symbol, and its unit (or as much of this information as is available and appropriate) are given in a box heading and are separated by commas. The unit is abbreviated. (Mark position of unit "Fol."; cf. GPO manual, p. 124, rule 140.)

EXAMPLE:

Corrected engine speed, $N/\sqrt{\theta}$, rpm
10,000
8,000

When a dash is used after a box head that reads into the matter following, the setup is as follows:

Total deformation, percent, after -			
500 hr	1,000 hr	1,500 hr	2,000 hr
0.375	0.457	0.536	0.640
.228	.330	.430	.620
.104	.125	.140	.152

In a group of related tables the corresponding parts should occupy similar positions and be in a consistent form.

When necessary to number columns for reference, the numbers are placed in parentheses or circled above the box headings and set off by a cross rule.

Column Material

Similar data should usually be placed in columns, not rows. If a column of values has a multiplying factor, the factor should be placed after the top value (other than zero) and not in the box head. It is not necessary to repeat the multiplying factor under a cross rule. Whenever possible, the author should give all comparable values to the same number of decimal places; however, such forms as 0.00 are usually unnecessary. Editors should not change tabular decimal values such as 2.300 to 2.30 or 2.3 if the degree of accuracy of the values might be affected. All minus signs should be given; no space should be left between the minus sign and the value. Plus signs should not be used to indicate the positive values but may be used to indicate such information as direction. The GPO will put leaders in any figure column

where values are not given. If leaders would be incorrect, the table should be marked "clear" in spaces where leaders are not desired. When an explanation is offered for a missing value in a column, a footnote should be added and the footnote reference mark given in parentheses at the proper place.

If identical values are obtained as test values, they should be repeated or, as a last resort, the value may be given once and an arrow drawn down the column to the next different value. If test conditions are identical for several test values, the conditions are usually given only once for the group of values to which they correspond. This grouping within columns may be shown by single horizontal rules or by spaces. If rules or spaces are impracticable, connected data may be indicated by braces. (See GPO manual, p. 125, rule 141.)

Sketches

If sketches are desirable as a part of a table, they may be used if the combination causes no make-up difficulties. A sketch that is part of a table is never considered a numbered figure.

Rules

Simple tables up to about four columns, either in the text or at the end of the paper, may be left unruled. Single rules are used except for special cases, such as division in doubled-up tables.

Subdivisions

If a table has subdivisions for different conditions, the heading for the first condition should be inserted directly after the lower cross rule of the box heads. It should be centered and separated from the data by a complete horizontal rule. Vertical rules do not cross subdivisions. Comparable subdivision headings should be written in the same style. Box heads and units should not be repeated if they are alike for all conditions, but the columns should be alined.

Subdivisions are generally used to indicate parts of a table; however, subtitles may be more appropriate at times and, occasionally, both may be necessary in complicated tables. Lower-case letters in parentheses designating the parts are always used with subtitles, but are used with subdivisions only when necessary for reference.

Footnotes

Footnotes should be used to explain peculiarities in individual values and may be used for any pertinent information that cannot be shown in the table. Lower-case letters are consistently used for footnote reference marks in NACA tables because the footnotes often refer to numerical values and thus numbers as reference marks might be ambiguous. In rare cases when letters would be ambiguous, asterisks or daggers may be used.

Reference marks begin anew for each table. They are introduced in the table from left to right and from top to bottom; that is, a footnote in the first row of the last column comes before one in the second row of the first column. If a footnote refers to a number, the reference mark is placed to the left of the number; before a negative value, it is placed before the minus sign. If the footnote refers to a word, the mark is placed directly after the word. (See also GPO manual, p. 131, rule 183.) If the footnote refers to all the values in one column, the mark is placed just above the bottom rule of the box head and enclosed in parentheses; however, if the footnote explains one term in the heading, the mark is placed with that term. The reference mark for a footnote referring to the entire title of a table is placed at the end of the title; the mark for a footnote referring to a part of the title is placed with that part.

The setup for footnotes at the bottom of the table is given in the GPO manual, pages 131 and 132, rules 185 to 194.

Size

Length and width of tables should be kept as nearly as possible in a ratio of 1.5:1 for typed papers. Also, for typed papers original tables larger than page size must be small enough to make the lettering legible after reduction to approximately 9 by 6 inches. For printed reports the setup is usually adjusted to a single- or double-column arrangement.

In order to obtain the proper proportions, short, wide tables may be divided with two horizontal rules separating the parts. Long, narrow tables may be divided into halves, thirds, and so forth and doubled up with two vertical rules separating the parts. In such doubled-up tables the box heads are repeated.

Folded pages of oversized tables may be used in either printed or typed papers only when it can be shown that their advantages outweigh the difficulties of reproduction and assembly. Enclosing such folded pages separately in envelopes is preferable to binding them in.

Large original tables which are to be reproduced may be rolled but should never be creased by folding.

FIGURES

Rules to be followed in preparing figures for printed reports are given in detail in "Report Figure Preparation" by Terence E. McCorkle and E. Nelson Hammerley. Editors should be thoroughly familiar with this manual. Rules for figures in both typed papers and printed reports are summarized in the following sections.

Layout

In typed papers figures - photographs, sketches, and graphs - are usually grouped together, placed after the tables, and numbered consecutively with Arabic numerals in the order of their mention in the text. (Exception to this order may be made when mention of the figure is clearly incidental.) Unnumbered figures which are an integral part of the paper can be left directly in the text. Such figures are prefaced by introductory remarks, are usually small, and may or may not have legends. Numbered figures are left in the text of typed papers only if both of the following conditions occur simultaneously: The text is dependent upon the position of the figure for the development of an idea and also numbers are necessary for frequent reference to the figure. (Cf. "Tables.")

As in typed papers, figures in printed reports are numbered in the order of their mention, unless the mention is clearly incidental. They are usually inserted consecutively in the text where they are mentioned.

In all papers figures intended to show comparisons should preferably be grouped together. Special grouping should be noted in the suggestions for reproduction.

In typed papers figures can sometimes be arranged two or more to a page. In laying out a series of figure pages in this manner, however, under no circumstances should the sequence of figures or parts of one figure be interrupted. Figures on one page should read from top to bottom or from left to right.

All lettering and numbers in a figure should read according to the position of the legend on the page when possible.

Size

The reduction of figures for printed reports usually will be to one- or two-column width. Illustrative figures are kept small, usually only a column wide, but design charts may be as large as necessary. Rules for the size and proportion of figures in typed papers and for folded pages are the same as those for tables. (See section "Tables.")

Legends

Because of their importance, figures, like tables, usually should be independent units. Figure legends should be concise, but they should also be adequately descriptive. In all papers legends are placed beneath figures and are set up according to the GPO manual, pages 159 and 160, rules 308 to 312.

Because lettering in all figures is preferably kept to a minimum, all explanatory matter and test conditions that are not a part of the key or labels should follow the main legend. If a table is part of the explanatory material, and not an integral part of the key, it preferably should be centered above or below the legend; however, other locations are permissible if they offer more convenience to the reader. Although the lettering in any figure should be uniform as to size and style, an exception may be made when typed legends are considered desirable. Usage should be consistent in any one paper.

A series of similar figures, for example, a group differing only by a change in test conditions, should be made into a composite figure with the portions differentiated by (a), (b), (c), and so forth and appropriate sublegends. In unusual cases such letters may be used without sublegends. Sublegends begin with a capital and end with a period. Each sublegend should be centered under the part of the figure to which it refers; however, when space is limited, sublegends may be placed inside each part or all the sublegends may be grouped immediately above the main legend. The indention of sublegends is the same as that for main legends.

If the several parts of a figure are on separate pages, the main legend is given once on the first page. On following pages there may be written simply "Figure 1.- Continued." and on the last page, "Figure 1.- Concluded."

For printed reports, if parts of a figure are to be separate cuts, the letters (a), (b), (c), and so forth should be used to aid the printer in placing the parts, even though no sublegends are given and the parts of the figure are not referred to in the text. The letters should be placed consistently on all parts of one figure. Also, for printed reports a separate list of figure legends should be typed and transmitted with the manuscript to the printer.

Types of Figures

Photographs.- Photographs may be used in a paper when they are necessary to clarify the text. Unnecessary and repetitious photographs should be avoided. In many cases simple sketches are better than photographs.

Although a photograph should have no superfluous details in the background, a person or some well-known object should be included to show comparative dimensions. If this is impracticable, a scale may be inserted.

If a photograph shows an object larger than its natural size, the magnification should be shown, preferably in the legend. Reproduction of such a figure should not change the magnification.

Original prints of photographs for reproduction should be clear in detail and of good tone gradation. Because of difficulties in reproduction, records from recording instruments may be used as illustrative material only after careful selection indicates that they will reproduce adequately. Photographs which may be difficult to reproduce should be accompanied by additional prints with the important areas encircled for special attention in reproduction.

For marks on the back of a photograph a grease pencil should be used or the marks should be made outside the portion that is to be reproduced. Care should be taken that the finish is never marred by marks or scratches and that photographs are never folded or rolled.

Rules for labeling parts of a photograph are the same as those given in the following section for sketches.

Sketches.- Parts of a sketch are preferably designated directly in the sketch by labels. The first word of a label is capitalized and no period is used at the end. The second and succeeding lines are usually centered under the first, although hanging indention may be used; the available space will determine which form the draftsman chooses. When the parts are identified by letters or numbers rather than word labels, they begin with A or 1 in the upper left-hand corner and proceed from left to right in horizontal rows whenever practicable. It is permissible to use circles or squares around the numbers or letters. These numbers or letters should be identified either in a key (see rules for keys in graphs) or after the legend.

When parts of a sketch must be differentiated, shading rather than color is used. Because shading with various degrees of grayness requires halftones for reproduction, shading with variously sized and spaced black dots and lines is preferred.

When dimensions indicated in a sketch are decimal fractions, initial zeros are not necessary. Dimensions may be given by writing foot and inch marks after the values; by putting the note "All dimensions are in inches." after the main legend; or by giving the scale of the drawing in the sketch.

Closed arrowheads are used to indicate dimensions, force, weight, or direction. Short leaders, without arrowheads, may be used from a label to the part of the sketch identified.

Graphs.- Because line graphs are the type of chart most often used to present data in NACA papers, the rules and examples in this section apply only to that type; however, other types of charts such as bar graphs may be used if the data are best presented in such a manner. The rules are given as follows for the itemized parts of a line graph:

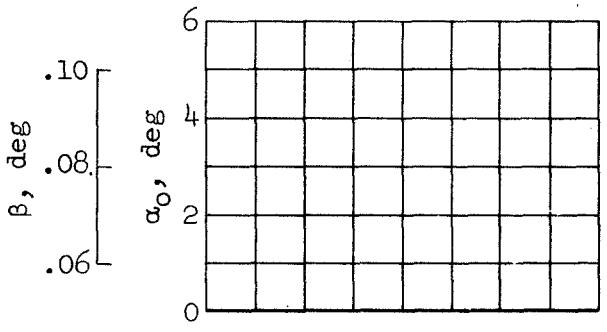
(1) Grid: Fine grid should be used if test points are to be read precisely from the figure. Coarse grid may be used for figures showing trends and comparisons.

Unless special plotting papers for coarse-grid figures are available, the grid in figures for typed papers should be drawn in on fine-grid paper far enough apart to reproduce clearly and the fine grid filtered out when the figure is reproduced. The grid lines should be drawn through curves and leaders and up to, but not through, test-point symbols. They should be broken around all lettering, labels, and keys and, to facilitate reading keys, no grid should be interspersed in the key. The zero lines should be distinctly bolder than the other grid lines. Whenever feasible, these rules for drawing in coarse grid should be applied to the preparation of fine-grid figures. Instructions about grid for figures in printed reports are given in "Report Figure Preparation" by McCorkle and Hammerley.

Except for logarithmic plots and other such special plotting systems, grid blocks should be squares whenever possible. Scale values should be selected with this in mind. Unless extra grid blocks are desirable for correct proportions or for possible extrapolation of curves, grid blocks should extend to include only the limits of the curves.

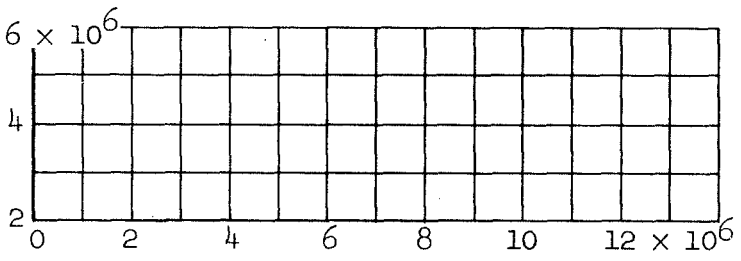
(2) Scales and scale labels: Scales are usually set up in standard form; that is, positive scale values apply to the first quadrant. Scale intervals should be such that interpolation is simplified. Even increments are therefore desirable.

Scale labels and values are usually placed outside the grid. If a figure has two scales on one side of the figure, the following setup is used:



If desirable, one of the scales may be placed on the right-hand side of the figure, but usage throughout one paper should be consistent. When space is limited, one of the scales and its label may be placed inside the grid if they do not interfere with the curves. Although ordinate scales have been used for illustration, these rules apply also to abscissa scales.

If the scale values are so large that they are best shown by a multiplying factor, the factor should be written after the highest value and not after the scale label; this factor should be placed inside the grid as shown in the following setup:



When scale values are decimal values, the initial zeros are omitted.

When the ordinate and abscissa scales intersect at the point (0,0), only one zero is used. The zero is alined horizontally with the other abscissa values and vertically with the right-hand numeral of the other ordinate scale values. When an ordinate scale is given on the right-hand side of a figure, the zero value is alined with the right-hand numeral of the other ordinate scale values.

Increments in scale values should be consistent for comparable figures. Scales usually extend the full length of the grid; however, in some cases the scale may not run the full length of the grid if extending the scale means running into an impossible region. The scale label should be centered with respect to the scale.

A quantity, its symbol, and its unit (or as much of this information as is available and appropriate) are given in a scale label and are separated by commas. The first letter of the first word of the label is capitalized and no period is used at the end. The unit is abbreviated. When simple fractions occur in both abscissa and ordinate scale labels, they should be set up similarly.

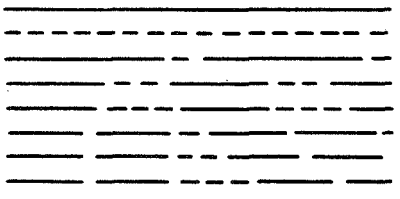
For easy reading ordinate scale labels are preferably written horizontally; however, long ordinate labels should be written vertically to save space or to preclude an unbalanced appearance of the figure. The second and succeeding lines of a label are usually centered under the first.

Scale labels are usually placed on the outer side of scale values. When space is limited, however, labels may be alined with the values at the center or at the top of the scale.

When words such as "Forward," "Back," "Push," "Pull," and "Rim" are applied to a scale, they are placed between the values and the label. On long scales they may be alined with the label if they are separated by sufficient space to avoid confusion.

Separate graphs, each complete with scales and scale labels, preferably should be made for the multiple parts of a figure whenever practicable; however, when space is limited, it may be desirable to use a common set of scales for all the parts. When the parts of a figure have common scales and scale labels, the numbered grid lines may be extended to connect the parts.

(3) Curves and curve labels: Dashed and solid lines are used to differentiate curves. Colored lines are not used. The preferred line order for the introduction of different kinds of curves in a figure is as follows:



In any one report the same line should be used to represent the same condition in related figures.

Curves are usually not broken for any reason other than to indicate a gap in the data. All lettering must be placed outside the path of the curve and must not interfere with possible extrapolation. Curves adjoin, but do not cross, test-point symbols.

Curves presenting experimental test data should ordinarily be substantiated by test points. No test points should show on curves resulting from cross-plotting or on curves showing purely mathematical relationships.

When identification of curves is needed, labels should be used unless there are so many curves that the lettering would cause difficulty in reading the curves. In such cases keys may be used. Curve labels may be set up in any usable form; however, it is desirable for the setup to be consistent in comparable figures of any one paper. Whenever practicable, curve labels are preferably grouped together and headed by their quantity and unit. Word labels have the first letter capitalized and no period at the end. Second and succeeding lines are usually centered under the first. When curve labels are decimal fractions, initial zeros are not used.

If it adds to the clarity of the graph, leaders may be used from curve labels to curves. Leaders should be as short as possible and should not interfere with reading of the graph.

(4) Test-point symbols: Symbols should be introduced in the following order; however, if a figure has been prepared in a different manner, the time involved in changing to this order should determine the feasibility of the correction:

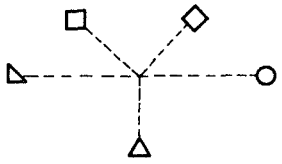
If data for more than 11 different test conditions are to be plotted, the following additional symbols should be used:

The symbols + and × and solid or filled-in symbols should be avoided. Flags and tails may be added in different positions to all the given symbols. Such symbols should be plotted so that the flags or tails do not coincide with curves and grid lines. All symbols within one figure should be the same size.

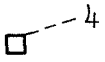
In any one report the same symbol should be used to represent the same condition in related figures or in a group of curves within one

figure. If it is desirable to use similar symbols for different sets of data, plain, tailed, and flagged points (not open and solid) should be used for differentiation. If necessary, after tailed and flagged symbols have been used, symbols with lines through the center may be used.

If several test-point symbols overlap and their identification is important, they may be plotted as follows:



or for identical values of the same quantity the plotting may be as follows:



(5) Keys: When keys, instead of labels, are used in figures, the following setups are typical for identification of either lines or test-point symbols:

Propeller speed, rpm		Propeller speed, rpm
———	1,000	○ 1,000
- - - - - - - - - -	1,350	□ 1,350

In cases when both test-point symbols and lines must be identified, the setup is as follows:

Propeller speed, rpm			Propeller speed, rpm
——○———	1,000	or	○——————— 1,000
- - - - -□- - - - -	1,350		□- - - - - - - - - - - - - 1,350

The heading is centered over the values rather than the entire key and the second and succeeding lines are usually centered under the first. When the items within the key are word labels instead of values, hanging indention may be used if space is available. Setups of keys in general follow the rules for tabular material and should be uniform for similar figures in any one paper.

Whenever possible, keys are placed within the grid. If necessary, keys may be placed at the side or at the top of the figure outside the grid. (Keys should be placed as close as possible to the material they define.)

TYPOGRAPHY

SPELLING LIST

In NACA papers the following words are spelled as indicated; words with an asterisk should be marked "Fol." in the copy for printed reports. The purpose of this list is to note spelling forms that differ from those in the GPO manual or Webster's dictionary, to give words not in either of these authorities, and to indicate a preference when two forms are given. To check the spelling and compounding of words not in this list, editors should follow these steps: (1) Use the GPO manual; (2) if the lists and rules for spelling and compounding in the GPO manual cannot be applied, use Webster's dictionary; and (3) for words not in Webster's dictionary consult standard authorities on the subject.

*aforementioned (adj.)
afterbottom (n.)
afterburner
afterfiring (n.)
afterkeel
aging (v.)
ailavator
*airborne (adj.)
air brake
air compressor
air-cooling (n.)
air course
air flow (n.)
airframe (n.)
*airline (n.)
*airspeed (n.)
airwheel
antidetonating
anti-icing
antispin
area-moment (n.)
asbestos (n. and adj.)
autoignite (v.)
autosyn

*backgear (n.)
ball check valve
bleedback
bleedoff
blow-by
bomb bay
*borderline (n.)
boundary layer
*breakaway (n.)
*breakdown (n.)
bungee

calorie
*camwheel
*capscrew
cap-strip
carburetion (n.)
*center line
chordwise
coaxial
cold-work (n.)
common rail
contravane
cooperate
coordinate
counterrotating
countervane
countervortex
countervorticity
*coworker
criticize
*crossarm
*crossbar

*crosscurrent
cross-fair (v.)
*crossflow (n.)
cross plot (n.)
cross-plot (v.)
*cutout (n.)

*dashpot (n.)
dead band
de-icer (n.)
diagrammed
dive bomber
downgoing
down load
down travel
*downwash (n.)
drag test
drive crank

end load
envelop (v.)
ethyl-cellulose
exit cone
eyebolt (not I-bolt)

*ferroalloy
flame holder
*flyer
fore flap
free stream (n.)
free to trim
*full-scale (adj.)

*gearbox
gearwheel
gram

half-angle
half-chord
half-flange
half roll (n.)
half-roll (v.)
half-wavelength (light)
half wave length (structures)
half-wing (n.)
hard-roll (v.)
*heat-treating
*high-grade (adj.)
*hot-work (n. and v.)

*I-beam (not eyebeam)
*inline engine
isooctane

Joukowski

lap-fitted
*layout
layshaft
locknut

Mach number
a Maclaurin series
by Maclaurin's series
macroetching
mass-balance (v.)
*materiel (distinguished from personnel)
microhardness
*mid-dome
mock-up

nondimensional
nonknock
*noseheavy
nose wheel

offbalance
oil cup

petcock
photoflash
photorecording
*pickup (n.)
plan form
Prandtl number
preignite (v.)
*pro-spin
push-down (n.)
push rod (n.)

radiosonde
ram-jet (adj.)
ram jet (n.)
rear flap
reengage
reestablish (v.)
reevaluate
reexamine

reexpansion (n.)
refinish
Reynolds number
roll-off (n.)
*run in (v.)

schlieren photograph
semichord
semiempirical
*series-multiple
*series-parallel
servocontrol (n.)
servo-operation
servopiston
servorudder
servotab
servovalve
sesquiplane
*setup (n.)
shock wave
*shutdown (n.)
side flow (n.)
sidewash
silver-soldered (adj.)
slip speed
*slipstream
solution-treat (v.)
solution-treating
solution treatment
spanwise
spinel
spray chamber
*startup
sternheavy
strain-harden (v.)
strain-hardening (n.)
stress-raiser (n.)
stress relief (n.)
stress-relief (adj.)
stress-relieved (v. and adj.)
suppressor
*sweepback (n.)
*sweep back (v.)
sweepforward (n.)
sweep forward (v.)
sweptback (adj.)
sweptforward (adj.)
swirl meter

tail cone
*tailheavy
tail post
take-off (n.)
*take off (v.)
taxiway
template
thrustmeter
torquemeter
tow car
tow cart
transonic
trim limit
turbine-propeller (adj.)
turbine propeller (n.)
turbojet
turbosupercharger

ultra-high frequency
ultralean
ultrarich
up elevator
up load
uprigging
up travel
upwash

V-tail or vee-tail

*washout
watercloth
Watt's linkage
wind-tee
wingheavy
*wormwheel

yaw head

PLURALS OF FOREIGN NOUNS

(Also, see GPO manual, p. 53)

Noun	NACA plural form
abscissa	abscissas
annulus	annuli
apex	apexes
apparatus	apparatus
equilibrium	equilibriums
focus	foci
helix	helices
lamina	laminae
maximum	maximums
meniscus	meniscuses
minimum	minimums
modulus	moduli
nucleus	nuclei
spectrum	spectra
vacuum	vacuums
vertex	vertices
vortex	vortices

ABBREVIATIONS

Usage

The general principle followed by the NACA in the use of abbreviations is that an abbreviated form should not be used unless it is appropriate to the style of the material in which it appears and is as familiar as the complete expression. Rules for abbreviations in the GPO manual are not generally applicable to NACA papers; therefore, in accordance with the third paragraph on page 93 of the GPO manual, specific usage in the various parts of an NACA paper is given as follows:

(1) In text, table titles, and figure legends: Because the textual part of an NACA paper is written in a formal technical style, only a few abbreviations are used in the text (including headings and footnotes), table titles, and figure legends. This usage is as follows:

(a) Units in a symbols list and transposed units in leader work are abbreviated.

(b) Long or complicated units with numerical values may be abbreviated, for example, Btu, rpm, ft/sec^2, cps, or Mev, especially if they recur frequently. Any units occurring with numerical values in the solution of a problem that is set off from the text by centering may be abbreviated.

(c) The degree sign is used and any accompanying scale or identification is abbreviated; for example, an angle of 40°, 17° A.B.C., 250° F, or 400° Bé.

(d) Magnification may be indicated in abbreviated form (e.g., X100) if it is mentioned so often that repetition of the written form is awkward.

(e) Abbreviations that are part of an official designation or trade name are used; for example, "No." is used when quoted but is avoided otherwise.

(f) Parts of material specifications, such as A.S.T.M., may be abbreviated.

(g) Initials used as shortened names of governmental agencies and of other organized bodies may be used after the full title has been given once in the body of the paper. The abbreviation "NACA" is preferable to "The Committee." The abbreviation should always precede the designation for a

member of an NACA family of airfoil sections, although it need be given only once when several airfoil sections are listed together. It should also precede other designations such as those for NACA instruments and nose inlets.

(h) Abbreviations are used within parentheses for mention of numbered equations, figures, references, or parts of references. Also within parentheses the abbreviations "e.g.," "etc.," "cf.," "i.e.," and "viz" may be used if desired. Except for the noted abbreviations parenthetical material follows the usage of the rest of the text.

(2) In tables and figures: Abbreviations may be used in any part of tables or figures with the exception of titles and legends as noted in the preceding paragraphs. (This usage also applies to tables and figures left directly in the text.)

(3) In references: Abbreviations may be used for all source material cited after the title of a listed reference.

List

Words in the following list may be abbreviated as shown, in accordance with the rules described in the preceding section for the various parts of a paper. When abbreviations other than those in this list are needed, reference should be made to recognized authorities such as Webster's dictionary or "Abbreviations for Scientific and Engineering Terms" (Z10.1-1941) published by the American Standards Association. Nonstandard abbreviations are permitted only in rare cases for reasons of economy in space. The NACA follows the practice of the ASA in writing all abbreviations of units, except "in." (inch), without periods. Periods are not used with abbreviations used as subscripts. Additional abbreviations should be selected from the authorities in accordance with these and other principles exemplified by the abbreviations in the list. The same abbreviation is to be used for both the singular and plural of units.

As a general rule all abbreviations are marked "Fol. abbrev." in the printer's copy for printed reports.

Abhandlung (transaction, German)	Abh.
abridged	abr.
Abschnitt (section, German)	Abschn.
absolute (as a unit)	abs
Abteilung (division or part, German)	Abt.
académie (academy, French)	acad.
academy	acad.
accademia (academy, Italian)	accad.

acoustical	acous.
Advisory Committee for Aeronautics (British, 1909-23)	ACA
aerodynamic center	a.c.
Aerodynamik (aerodynamics, German)	Aerod.
aerodynamics	aerod.
aeronautical, aeronautics	aero.
Aeronautical Research Committee or Council (British, since 1923)	A.R.C.
aerotecnica (aeronautics or aerodynamics, Italian)	aero.
after bottom center	A.B.C.
after post	A.P.
after top center	A.T.C.
Air Corps Information Circular	A.C.I.C.
Air Corps Technical Report	A.C.T.R.
Aircraft Fuel Development	AFD
Air Service Information Circular	A.S.I.C.
Akademie (academy, German)	Akad.
alternating-current (as adjective)	a-c
American	Am.
American Petroleum Institute	A.P.I.
American Society for Metals	A.S.M.
American Society for Testing Materials	A.S.T.M.
American Society of Mechanical Engineers	A.S.M.E.
American Standards Association	ASA
Ames Aeronautical Laboratory	AAL
ampere	amp
ampere-hour	amp-hr
ampere-second	amp-sec
and (in proper names when so given)	&
and others	et al.
and so forth	etc.
angstrom	A
Annalen (annals, German)	Ann.
annales (annals, French)	ann.
annali (annals, Italian)	ann.
anonymous	anon.
Anstalt (institution, German)	Anst.
applicata (applied, Italian)	appl.
applied	appl.
approximately	approx.
architect	arch.
Army-Navy-Commerce	ANC
article, articles	art., arts.
Artikel (article, German)	Art.
association	assoc.
associazione (association, Italian)	assoc.
atmosphere (as a unit)	atm

atti (proceedings, transactions, or acts, Italian)	spell out
Ausgabe (edition, German)	Ausg.
average	av.
Aviation Fuels Division	AFD
Aviation Petroleum Branch	APB
balance	bal.
Band (volume, German)	Bd.
barometer	bar.
Baumé	Bé
before bottom center	B.B.C.
before top center	B.T.C.
Bericht (report, German)	Ber.
Bericht der deutschen chemischen Gesellschaft	Ber. D. Chem. Gesell.
beziehungsweise (respectively, German)	bzw.
boiling point	b.p.
bollettino (bulletin, Italian)	boll.
bottom center	B.C.
brake horsepower	bhp
brake horsepower-hour	bhp-hr
brake mean effective pressure	bmep
brake specific fuel consumption	bsfc
Brinell hardness number	Bhn
British thermal unit	Btu
Brown & Sharpe (gage)	B. & S.
bulletin, bulletins	bull., bulls.
bureau	bur.
calculated	calc.
California Institute of Technology	C.I.T.
calorie	cal
candlepower	cp
Cartesian mapping function	CMF
center of buoyancy	c.b.
center of gravity	c.g.
center of pressure	c.p.
center to center	c. to c.
centigrade	C
centigram	cg
centiliter	cl
centimeter	cm
centimeter-gram-second	cgs
chapter, chapters	ch., chs.
chemically pure	c.p.
chemistry, chemical	chem.
chimica (chemistry, Italian)	chim.

circolo (club, Italian)	spell out
circular	cir.
circular mils	cir. mils
civil	civ.
Civil Aeronautics Administration or Board	CAA, CAB
classe (class, Italian)	cl.
coefficient	coeff.
collection, collections	coll.
commission	comm.
company	co.
compare	cf.
compression ratio	c.r.
conference	conf.
congress	cong.
construction	constr.
Cooperative or Coordinating Fuel Research	CFR
Cooperative Universal Engine	CUE
Coordinating Fuel Research Committee (changed Jan. 1944 from Cooperative)	CFR Committee
Coordinating Research Council (changed Jan. 1944 from Cooperative)	CRC
copyright	c.
corporation	corp.
critical	crit.
cubic	cu
cubic centimeter (liquid)	cc
cubic centimeter (volume)	cm^3
cubic feet per second	cu ft/sec
cubic inch	cu in.
cycles per minute	cpm
cycles per second	cps
cylinder	cyl.
decibel	db
deel (part, Dutch)	dl.
degree (separated from numbers)	deg
degree (with numbers and in ^oF, ^oR, ^oC, and so forth)	o
department	dept.
Deutsche Forschungsanstalt für Luftfahrt	D.F.L.
Deutsche Versuchsanstalt für Luftfahrt	DVL
development	dev.
diameter (no period when a unit)	diam.
direct-current (as adjective)	d-c
discussion	spell out
dissertation	diss.
ditto	do.
division, divisions	div., divs.
document	doc.

edition, editions	ed.
édition (edition, French)	éd.
editor, editors	ed., eds.
effective horsepower	ehp
efficiency	eff.
elastic center	e.c.
electric, electrical	elec.
electric horsepower	elec. hp
electromotive force	emf
elektrotechnisch (electrotechnical, German)	elektrotech.
engine (spell out if confusing)	eng.
engineer, engineering (spell out if confusing)	eng.
enlarged	enl.
equation, equations	eq., eqs.
Ergebnis (result, German)	Ergb.
exercise	ex.
exhaust closes	E.C.
exhaust opens	E.O.
experiment, experimental	exp.
external	ext.
Fahrenheit	F
farad	f
fascicolo (part or number, Italian)	fasc.
fascicule (part or number, French)	fasc.
feet per minute	ft/min
feet per second	fps or ft/sec
feet per second per second	ft/sec^2
figure, figures	fig., figs.
fisica (physics, Italian)	fi.
fisico (physical, Italian)	fis.
foot	ft or '
foot-pound	ft-lb
fore post (or forward perpendicular)	F.P.
for example	e.g.
Forschung auf dem Gebiete des Ingenieurwesens	Forsch. Geb. Ing.-Wes.
Forschungsarbeiten	Forsch.-Arb.
freezing point	f.p.
friction horsepower	fhp
friction mean effective pressure	fmep
für (for, German)	f.
gallon	gal
gallons per hour	gal/hr
Gebiete (field or branch (of research), German)	Geb.
general	gen.
geographic	geog.

geophysical	geophys.
Gesellschaft mit beschränkter Haftung (company with limited liability, German)	G.m.b.H
giornale (journal, Italian)	gior.
government	govt.
Government Printing Office	GPO
grain	spell out
gram	g
gram-calorie	g-cal
Guggenheim Aeronautical Laboratory, California Institute of Technology	GALCIT
Handbuch (manual, German)	Handb.
Heft (number, German)	spell out
henry	h
Herausgeber (editor or publisher, German)	Hrsg.
herausgegeben (edited or published, German)	hrsg.
Hochschule (university, German)	H.S.
horsepower	hp
horsepower-hour	hp-hr
hour	hr
hydrodynamics	hydrod.
inch	in. or "
inches of mercury	in. Hg
inches of water	in. H_2O
inch-pound	in-lb
incorporated	inc.
indicated fuel consumption	ifc
indicated horsepower	ihp
indicated mean effective pressure	imep
industria (industry, Italian)	ind.
industrial, industry	ind.
ingegneria (engineering, Italian)	ing.
Ingenieur (engineer, German)	Ing.
initial temperature difference	ITD
injection advance angle	i.a.a.
inside diameter	I.D.
institute	inst.
instituto (institute, Italian)	inst.
instruments	instr.
intake closes	I.C.
intake opens	I.O.
internal	int.
international	int.
International Standards Association	I.S.A.
investigation	invest.
iron pipe size	I.P.S.

Jahrbuch (yearbook, German)	Jahrb.
Jahrgang (annual publication, German)	Jahrg.
joule	j
journal	jour.
Junior	Jr.
Kapitel (chapter, German)	Kap.
kilocalorie	kcal
kilocycle	kc
kilocycles per second	kcps
kilogram	kg
kilogram-calorie	kg-cal
kilogram-meter	kg-m
kilometer	km
kilowatt-hour	kw-hr
kips per square inch (structures papers only)	ksi
Kongress (congress, German)	Kong.
laboratory, laboratories	lab., labs.
Langley Aeronautical Laboratory	LAL
leading edge	L.E.
lecture	lect.
left hand	l.h.
lens aperture (of 8)	f/8
Lewis Flight Propulsion Laboratory	LFPL
library	lib.
Lieferung (issue or number (of books and magazines), German)	Lfg.
Lilienthal-Gesellschaft für Luftfahrtforschung	L.G.L.
limited	ltd.
Lincei (old Italian scientific society)	spell out
linear	lin.
liquid	liq.
liter	spell out
logarithm (common)	log
logarithm (natural)	$\log_e$
magazine	mag.
magnified fifty times	X50
manufacturer	mfr.
manufacturing	mfg.
manuscript, manuscripts	ms., mss.
Massachusetts Institute of Technology	M.I.T.
matematica (mathematics, Italian)	mat.
mathematics	math.
Mathematik (mathematics, German)	Math.
maximum	max.

mean aerodynamic chord	M.A.C.
mean effective pressure	mep
mean geometric chord	M.G.C.
meccanica (mechanical, Italian)	mec.
mechanical, mechanics	mech.
medicine	med.
melting point	m.p.
memorandum	memo.
Memorandum Report	MR
memoria (memoir, Italian)	mem.
metallurgy, metallurgical	metall.
meter	m
microfarad	μf
microinch	μin.
micromicrofarad	μμf
micron	μ
mile	spell out
miles per hour	mph
milliampere	ma
millibar	mb
milligram	mg
milliliter	ml
millimeter	mm
millimicrofarad	mμf
millimicron	mμ
million electron volts	Mev
millivolt	mv
minimum	min.
minute	min
minute (angular measure)	'
miscellaneous	misc.
Mitteilungen (communications, German)	Mitt.
month (as a unit)	spell out
months (for any language)	Jan., Feb., Mar., Apr., Aug., Sept., Oct., Nov., Dec.
namely	viz
national	nat.
National Advisory Committee for Aeronautics	NACA
National Aeronautic Association	N.A.A.
National Physical Laboratory (England)	NPL
naturali (natural, Italian)	nat.
nazionale (national, Italian)	naz.
number, numbers	no., nos.
Numero, Nummer (number, German and Dutch)	Nr.

ohm	spell out or Ω
ordnance	ord.
ounce	oz
outside diameter	O.D.
page, pages	p., pp.
paragraph, paragraphs	par., pars.
part, parts	pt., pts.
percent	spell out or %
petroleum	petr.
philosophical	phil.
physics, physical	phys.
Physik (physics, German)	Phys.
plate, plates	pl., pls.
politecnico (polytechnical, Italian)	politec.
pound	lb
pound-foot	lb-ft
pound-inch	lb-in.
pounds per brake horsepower-hour	lb/bhp-hr
pounds per square inch	lb/sq in.
pounds per square inch (structures and materials papers only)	psi
pounds per square inch absolute (structures and materials papers only)	psia
Pratt & Whitney	P. & W.
pressure	press.
proceedings	proc.
progress	prog.
publication, publications, publishing	pub.
published, publisher	publ.
radian	spell out
radius (no period when a unit)	rad.
Rankine	R
reale (royal, Italian)	r.
recerche, ricerca (research, Italian)	spell out
recherche (research, French)	rech.
reference, references	ref., refs.
rendiconti (accounts of, report of, Italian)	spell out
reparto (division or part, Italian)	rep.
report, reports	rep.
Reports and Memoranda (British)	R. & M.
research	res.
Research Memorandum	RM
review	rev.
revised (spell out if confusing)	rev.

revolutions per minute	rpm
revolutions per second	rps
revue (review, French)	rev.
right hand	r.h.
rivista (review, Italian)	riv.
root mean square or square root of mean square	rms
royal	roy.
Royal Aeronautical Society	R.A.S.
Royal Aircraft Establishment	R.A.E.
Saybolt Universal (or Furol) Seconds	SUS, SFS
Schrift (publication, German)	Schr.
science, scientific	sci.
scienze (science, Italian)	sci.
scuola (school, Italian)	spell out
second	sec
second (angular measure)	"
section, sections	sec., secs.
Serie (series, German)	Ser.
série (series, French)	sér.
series, serial	ser.
sindacato (official group, Italian)	spell out
Sitzungsbericht (proceedings, German)	Sitzungsber.
slug-feet^2	slug-ft^2
società (society, Italian)	soc.
society	soc.
Society of Automotive Engineers	SAE
specification, specifications	spec.
specific fuel consumption	sfc
specific gravity	sp. gr.
specific heat	sp. ht.
sperimentale (experimental, Italian)	sper.
square centimeter	cm^2 or sq cm
square inch	sq in.
supplement, supplements	supp., supps.
system	syst.
table	spell out
technical	tech.
Technical Memorandum	TM
Technical Note	TN
technique (technical, French)	tech.
technisch (technical, German)	tech.
Technische Berichte (technical report, German)	T.B.
Technische Hochschule (institute of technology, German)	Tech. H.S.
technology, technological	tech.
tecnica, tecnico, tecnici (technical, Italian)	tec.

Teil (part, German)	spell out
temperature	temp.
tetraethyl lead	TEL or $PbEt_4$
that is	i.e.
theoretical	theor.
thousand pounds	kip
thrust horsepower	thp
tome (volume, French)	t.
tomo (volume, Italian)	t.
top center	T.C.
trailing edge	T.E.
transactions	trans.
translated, translator	trans.
universita (university, Italian)	univ.
university	univ.
velocity	vel.
Verein deutscher Ingenieure	VDI
Verhandlung (transaction, German)	Verh.
volt	v
volume, volumes	vol., vols.
Vortrag (lecture or verbal report, German)	Vortr.
water line	WL
watt	w
weight	wt.
wetted length	W.L.
Wissenschaft (science, German)	Wiss.
Wright Aeronautical Corporation	W.A.C.
yard	yd
year	yr
Zeitschrift (periodical, German)	Zs.
Zeitschrift des Vereines deutscher Ingenieure	Z.V.D.I.
Zeitschrift für angewandte Mathematik und Mechanik	Z.a.M.M.
Zeitschrift für Flugtechnik und Motorluftschiffahrt	Z.F.M.
Zeitung (journal, German)	Zeit.

MATHEMATICAL EXPRESSIONS

Mathematical expressions that occur frequently in NACA papers include equations, inequalities, relationships, conditions, limits, and so forth. The style of setup for all such expressions is the same; however, for convenience, and because they occur most often, equations are mainly discussed in the following paragraphs.

Short, simple equations may be run in the text of a paper whenever it is desirable to do so. It is necessary, however, to set off most equations from the text by spacing and numbered equations are always set off. An equation and the introductory material that directly precedes it should be presented in correct grammatical form. They may be connected by a colon, a comma, or a dash, or no mark of punctuation may be necessary. Punctuation is not used after equations set off from the text.

Equations needed for reference are numbered as (1), (2), (3), and so forth throughout the text. Identification such as (1a) and (1b) may be used for equivalent or derivative equations. A brace should be used to connect a group of equations with the same number. Equations in appendixes should be numbered either in consecutive order following the equations in the text or as (A1), (A2), (B1), (B2), and so forth corresponding to the appendix in which they appear. The numbers for equations are usually set flush with the right margin at the end of the equation, with space left for separation from the equation. If there is insufficient room for the number after a centered equation, the equation may be set off-center. When necessary, the number is set below the equation. The equation number should be used to refer to the equation instead of repeating it; however, if it is necessary to repeat a numbered equation, it should be clearly identified as the same equation previously given. The parentheses are retained around the number when the equation is mentioned.

The following unpublished instructions supplied by the GPO are to be followed in all papers for equations set off from the text:

"Equations which do not require run-overs are centered in the measure in which they are set.

"In equivalent or derivative equations requiring run-overs, break before equal signs and aline them--if necessary to break the equation at additional places, the run-overs must clear the equal signs. Equivalent or derivative equations requiring run-overs are centered in the measure as a unit.

"In all other equations requiring run-overs, the run-overs will clear the equal sign, if the part preceding the equal sign contains less than one-fourth of the matter in the first line and if the equation can be broken to advantage. Where the run-overs clear the equal sign, the equation is centered in the measure as a unit. Where the run-overs do not clear the equal sign, the first line and the run-overs are alined on the left and the longest line is centered in the measure.

"In breaking equations for typographical convenience, break after mathematical signs, except that in equivalent or derivative equations, the equations will be broken before equal signs and after other mathematical signs. Where unable to break on mathematical signs, equations may be broken before mathematical terms such as cos, sin, tan, log, etc. Equations containing a succession of integral signs may be broken before one of the integrals. Equations will not be broken at any other place unless necessary.

. . . . . .

"In equations with run-overs, unreasonably short lines will be avoided, but small groups enclosed in braces, brackets, or parentheses must not be broken--larger groups may be broken if a satisfactory break cannot be made at another mathematical sign.

. . . . . .

"Horizontal rules used in ratios and roots cannot be broken. If it is necessary to break matter above or below a rule, use brackets or braces and extend them to include both lines of the break--in the case of a ratio, the entire ratio may be enclosed in brackets or braces.

"Where text is doubled-up in two columns, equations may be set full measure, if advisable, to avoid breaking matter enclosed in braces, brackets, or parentheses. Equations may also be set full measure if they contain extra long ratios or roots. Where one full-measure equation follows another, in close order, any text or equations falling between them will also be set full measure."

In a typed paper equations that cannot be broken and that are longer than the width of a page should be photographed with a reduction to page width and stripped in on the negative. If this is not feasible, they may be typed lengthwise of the page. For similar long and involved mathematical setups in a printed report, the manuscript pages can be submitted to the printer without reduction and marked "Set full measure."

Related equations grouped without intervening text are alined on the left and centered in the measure according to the longest line of the group.

Equations are preferably given in such form that all the concepts involved are expressed by symbols. The use of words or phrases should be avoided unless practical considerations indicate them to be desirable; for example, simple words like "Drag" and "Lift" might be used to avoid defining additional symbols which would otherwise not require definition. The first letter of each such word or phrase should be capitalized if it takes the place of a main symbol; it is not capitalized if it appears as a subscript to a symbol.

In lines containing fractions with horizontal bars the bars of all fractions are alined and centered on other symbols and numbers not in fractions. A slant line instead of a horizontal bar may be used in equations to keep the terms to the same height and in simple fractions throughout the paper if no misinterpretation will result.

Values repeated in various parts of a paper should be given in the same form; that is, 1/4, one-fourth, and/or 0.25 should not be used synonymously for one value. An initial zero is always used with a decimal fraction in the text.

Parentheses, brackets, and braces - in this order - should be used to enclose a part of a mathematical expression used as a unit. Exceptions are made to this order of introduction when special mathematical meaning is indicated such as vector and scalar products, functions, limits, and so forth.

CHEMICAL SYMBOLS

Because chemical symbols for the elements are generally known, they may be used without further identification in all parts of a paper that is allied with the field of chemistry. Even in a chemical paper, however, if only a few isolated symbols are used, they are preferably written out as a matter of propriety in style. For subject fields not allied with chemistry the names of the elements should be used or, in rare cases when the elements are mentioned many times, symbols may be used if identified at their first occurrence.

Except for common formulas that are well-known to engineers in all fields, chemical compounds should be identified by name in all papers. If the compound recurs frequently, the formula may be identified and then used for subsequent mentions.

LEADER WORK

Rules for leader work given in the GPO manual, pages 135 to 137, should be followed with the exception of the example for mixed units of quantity and amounts under rule 220. The setup for such leader work should be as follows:

Mach number, M	0.728
Wing span, b, ft	41
Aspect ratio, A	5.6
Limit diving speed, V_L, mph	553

TYPE FACES FOR PRINTED REPORTS

Type faces for printed reports are standardized; different type faces for special usage may be recommended, but NACA Headquarters will have to approve them. For reference in marking the manuscript of a printed report some of the most often used type faces are labeled in the following examples. (Note that the examples are given merely to show type faces and are not necessarily illustrative of current NACA report style.) In addition to the examples shown, the following type faces are used:

Appendix title is case 130 caps.

Fourth-order heading (underlined caps in typed papers) is case 131 caps in text.

Vectors are to be indicated by letters in bold face type, case 131 in text and case 129 in footnotes.

Abbreviations even when used as symbols are roman type.

All letters as well as words that are ordinarily roman become italic when used as subscripts, superscripts, or limits.

REPORT 924 —— Case 133 14 pt.

Case 132
12 pt.

APPLICATION OF THEODORSEN'S THEORY TO PROPELLER DESIGN

By JOHN L. CRIGLER ——— 8 pt. Modern

SUMMARY

A theoretical analysis is presented for obtaining by use of Theodorsen's propeller theory the load distribution along a ——— 10 pt. Modern italic

INTRODUCTION ——— Case 130 8 pt.

Recent contributions to the theory of propellers have been made by Theodorsen in a series of reports (references 1 to 4). ——— 10 pt. Modern

ILLUSTRATIVE EXAMPLES ——— Case 129 6 pt.

Single rotation. ~~Let the following data specify the~~ ——— Case 14 10 pt. Clarendon propeller design conditions:

Power, horsepower	2,000
Density, slugs per cubic foot	0.001065
Velocity, miles per hour	425

——— 8 pt. Modern

LANGLEY AERONAUTICAL LABORATORY,
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS,
LANGLEY FIELD, VA., *June 30, 1948.*

——— 10 pt. Modern

APPENDIX ——— Case 132 12 pt.

TABLE I

SOUND-PRESSURE LEVELS OF AIRPLANES AND AIRPLANE COMPONENTS ——— 8 pt. Modern

Airplane component	Sound-pressure level at 300 ft, db

——— 6 pt. Modern

REFERENCES

1. Phillips, W. H., Williams, W. C., and Hoover, H. H.: Measurements of the Flying Qualities of a Curtiss SB2C-1 Airplane (No. 00014). NACA MR, March 14, 1944.
2. Gilruth, R. R.: Requirements for Satisfactory Flying Qualities of Airplanes. NACA Rep. 755, 1943.

——— 8 pt. Modern

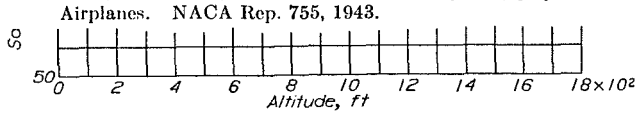


FIGURE 11.—Effect of altitude on sound-pressure levels. Full power and maximum speeds. Unmodified and modified test airplanes.

——— 6 pt. Modern

INDEX

NACA-Langley - 10-22-52 - 500